

Treatment of anterior open-bite using zygomatic anchorage: a 10-year follow-up case report

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Aim: To present the treatment and long-term post-treatment results of an adult case presenting with an Angle Class II anterior open-bite malocclusion that involved the use of zygomatic anchorage for the intrusion of the maxillary posterior teeth.

Methods: A 23-year-old female patient with a bilateral Angle Class II molar and canine relationship, a 4 mm overjet and a 6 mm anterior open-bite was treated using zygomatic anchorage in order to correct the dental and skeletal relationships, and eliminate the anterior open-bite to achieve an ideal overjet, overbite and improved facial aesthetics. Orthodontic brackets were placed on the maxillary and mandibular teeth. Under local anaesthesia, a subperiosteal flap was raised, and two titanium miniplates were bilaterally placed in the zygomatic area. The molars were intruded by applying 400 grams of force to the miniplates via connection to the upper arch wire.

Results: By intruding the molar teeth using zygomatic anchorage, the anterior open-bite was corrected to achieve an Angle Class I occlusion, an ideal overbite and a harmonious facial profile that were successfully maintained after a 10-year follow-up period. (Aust Orthod J 2020; 36: 211-219)

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Introduction

Skeletal open-bite malocclusions are characterised by increased lower facial height and a steep mandibular plane angle caused by over-erupted maxillary posterior teeth.¹⁻⁴ Successfully treating and maintaining the correction of poor vertical relationships can be challenging, especially in adult cases. While orthognathic surgery, with or without mandibular ramus osteotomy, can be used to intrude maxillary posterior teeth and reduce lower facial height,⁸ patients often refuse surgery because of the associated risks and high costs. The literature also describes a range of orthodontic treatment options, most of which are focused on extruding incisors and/or preventing the eruption of posterior teeth.⁵⁻⁷ Several clinical methods have also been developed as an alternative to orthognathic surgery for the intrusion of maxillary posterior teeth.¹² Treatment with extra-oral appliances is associated with a number of disadvantages, such as pain, poor aesthetics, and difficulties with

patient compliance. Onplants,¹³ miniscrews,¹⁴ mini-implants,¹⁵ palatal implants,¹⁶ endosseous implants¹⁷ and miniplates have been introduced to eliminate these problems.^{10,18,19} Implants used for molar intrusion are most commonly placed in the anterior palate, buccal or palatal interdental alveolar bone or in the zygomaticomaxillary buttresses.²⁰

The use of a zygomatic anchorage system to intrude and/or distalise teeth was first described by De Clerck et al. in 2002.²⁰ The system relies on the application of a reactive force to alter the orthodontic force vector, and because there is no need for osteo-integration, immediate loading is possible. Moreover, patient co-operation is not required. The following case report is that of an adult patient with an Angle Class II anterior open-bite malocclusion treated using zygomatic anchorage for the intrusion of the maxillary posterior teeth. The treatment results and long-term follow-up are presented.

Case report

Diagnosis

A 23-year-old female patient was referred to the Department of Orthodontics at the Ankara University Faculty of Dentistry with the chief complaint of an anterior open-bite. A clinical examination revealed a bilateral Angle Class II molar and canine relationship, a 4 mm overjet, and a 6 mm anterior open-bite. The patient's right maxillary canine (Tooth No. 13) and left mandibular first molar (Tooth No. 36) had been extracted during childhood, which created a 1.5 mm midline shift to the right in the upper arch, and a 4 mm midline shift to the left in the lower arch. The patient's vertical proportions were increased and a convex profile was present (Figure 1).

A model analysis indicated 1.5 mm crowding in the maxillary arch and 3 mm anterior crowding in the mandibular arch as well as a 2 mm space in the mandibular arch due to the extraction of the first molar.

A pretreatment lateral cephalometric analysis showed a skeletal Angle Class II malocclusion with a high mandibular plane angle vertical pattern and proclined

upper and lower incisors (Figures 2,3). A differential diagnosis²¹ of morphogenetic open-bite was made based on the patient's long and narrow symphysis, pronounced antegonial notch, increased lower facial height, and incompetent lips. Pretreatment panoramic radiographs revealed the presence of all third molar teeth and restorations in the posterior teeth in both arches (Figure 4).

Treatment objectives

Treatment involved the correction of the dental and skeletal relationships to eliminate the anterior open-bite and improve facial aesthetics by achieving an ideal overjet and overbite.

Treatment alternatives

Two treatment options were proposed: orthognathic surgery to impact the posterior maxilla, or orthodontic treatment using zygomatic miniplate anchorage to intrude the maxillary posterior teeth. The patient refused orthognathic surgery and preferred orthodontic treatment.



Figure 1. Pretreatment extra- and intra-oral photographs of the patient.

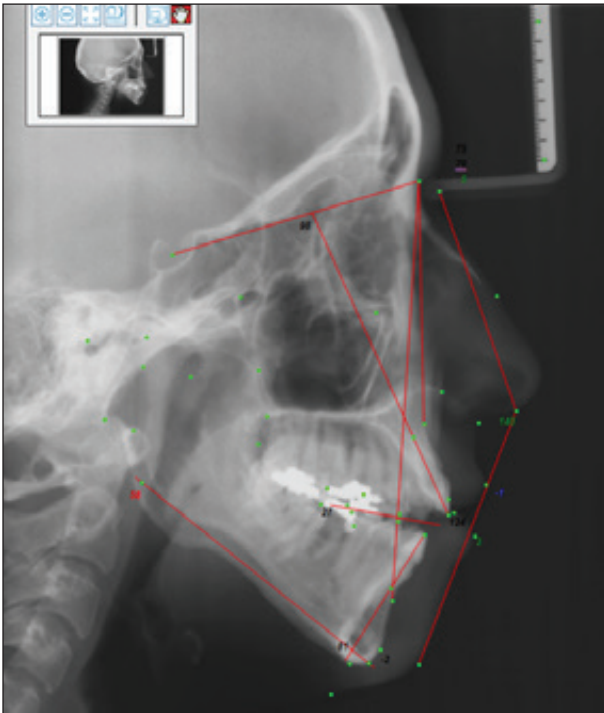


Figure 2. Pretreatment lateral cephalometric radiograph of the patient.

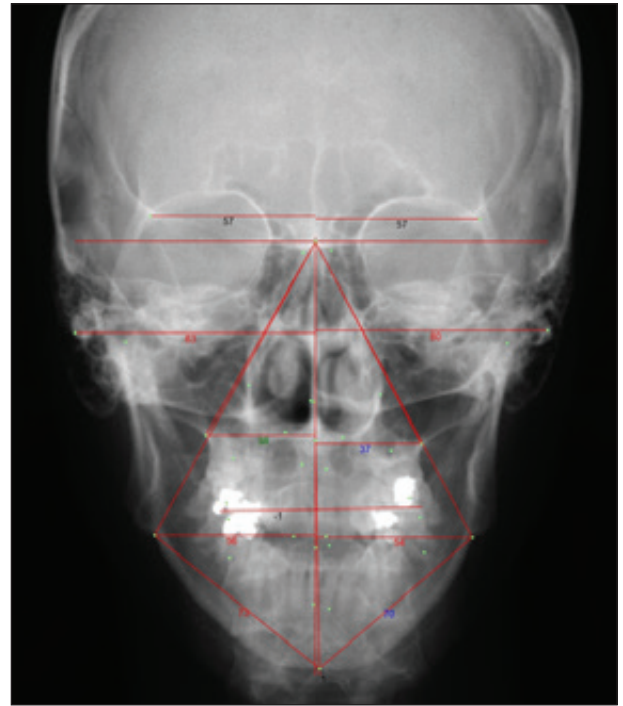


Figure 3. Pretreatment posteroanterior radiograph of the patient.

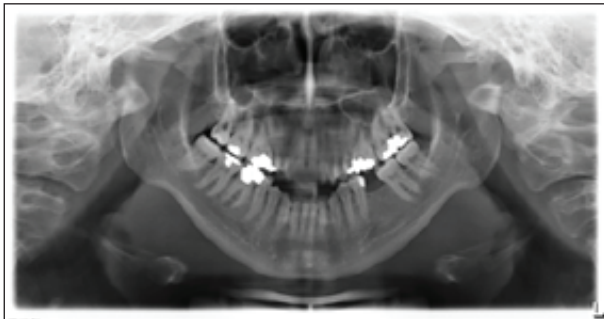


Figure 4. Pretreatment panoramic radiograph of the patient.

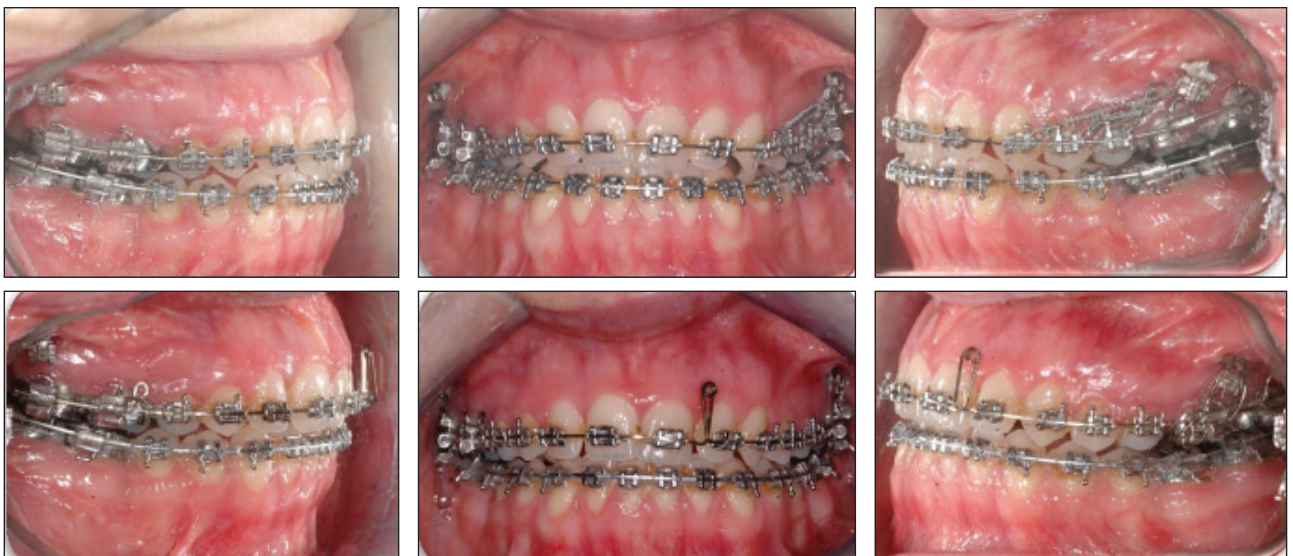


Figure 5. Intra-oral photographs of the patient with orthodontic appliances.



Figure 6. Post-treatment extra- and intra-oral photographs of the patient.

Treatment progress

Prior to treatment, the mandibular right first molar was extracted due to severe damage to the crown and questionable restorations. Pre-adjusted Roth Edgewise orthodontic brackets (0.018"; Ormco Corp. CA, USA) were placed on the maxillary and mandibular teeth (Figure 5). Nickel-titanium arch wires were used for levelling and aligning, and a transpalatal arch was applied between the maxillary molars to prevent buccal crown tipping during intrusion. Once levelling and alignment were complete, under local anaesthesia, a subperiosteal flap was raised, and two titanium miniplates were bilaterally placed in the zygomatic area, with the distal posterior end of each miniplate located intra-orally between the first and second molars. After a two-week delay to allow for soft-tissue healing, stainless steel arch wires (0.017 × 0.025") were attached to the miniplates, and a force of 400 grams was applied²²⁻²⁴ to deliver molar intrusion. Intrusion was maintained with wire ligation between the miniplates and the molar tubes. The total time required for intrusion was 10 months.

Once a satisfactory overbite and occlusion were secured, the orthodontic brackets were debonded, and a maxillary Hawley appliance and mandibular canine-to-canine fixed lingual retainer were delivered for retention, and the patient was referred for surgical removal of the miniplates. The total treatment duration was 27 months.

Results

Following active treatment, the vertical and sagittal relationships and profile improved significantly (Figure 6), the anterior open-bite and midline deviations were corrected, and an Angle Class I molar and canine relationship with an ideal overjet and overbite were achieved.

Post-treatment cephalometric analysis showed molar intrusion and a mandibular counter-clockwise autorotation, as expected (Figures 7,8). Post-treatment panoramic radiographs showed no signs of apical resorption and the third molars were present and erupted into the dental arch (Figure 9). Bjork's

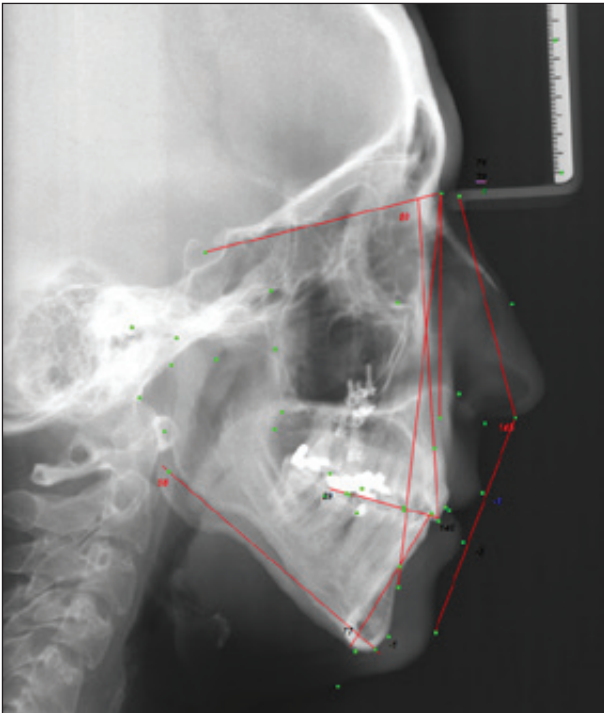


Figure 7. Post-treatment lateral cephalometric radiograph of the patient.

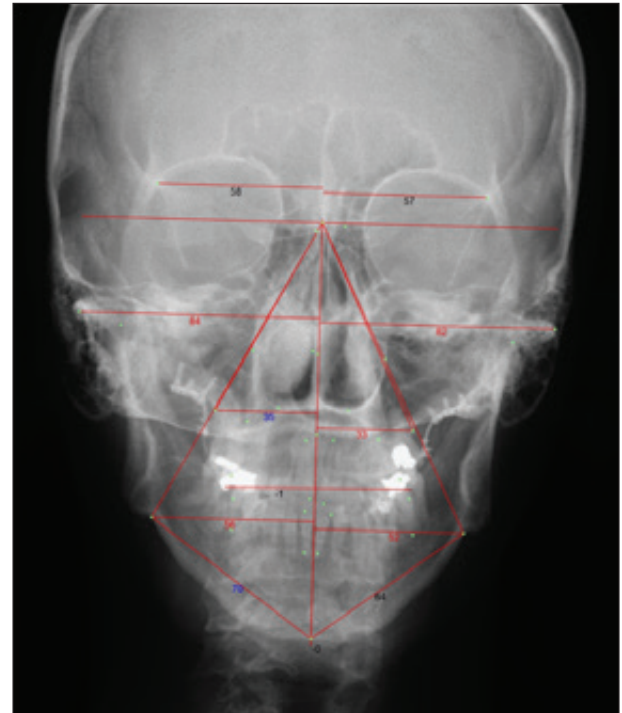


Figure 8. Post-treatment posteroanterior radiograph of the patient.

Table I. Pretreatment, post-treatment and 10 years follow-up lateral cephalometric analysis.

	Pretreatment	Post-treatment	10 years follow-up
SNA	79.5°	78.5°	79°
SNB	73°	73°	74.3°
ANB	6.5°	4.5°	4.7°
SND	70°	70°	70°
I-NA	5mm / 21°	0mm / 10°	0.4mm / 10°
I-NB	7.5mm / 27.5°	6mm / 26°	7mm / 27°
Pg-NB	-2mm	-2mm	-1
Holdaway	9mm	8mm	8mm
Interincisal angle	125°	137°	137°
Occlusal plane/SN	25.5°	25°	25°
GoGn/SN	51°	50°	49.4°
Steiner soft tissue line upper lip/lower lip	0mm / 2.5mm	-1mm / -1mm	0.7 / 1.8mm

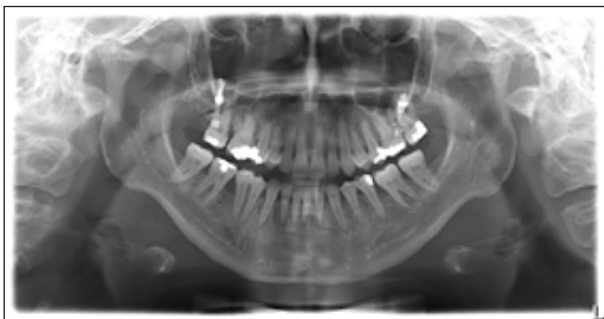


Figure 9. Post-treatment panoramic radiograph of the patient.

structural total and local superimpositions revealed retrusion of the maxillary and mandibular incisors, mesial movement of the mandibular molars, and distal movement of the maxillary molars (Figures 10,11).

Extra- and intra-oral photographs, lateral and antero-posterior cephalometric radiographs with tracings, and panoramic radiographs (Figures 12-15) taken after 10 years of follow-up indicated that the orthodontic outcomes were largely maintained but with a little clinically acceptable relapse.

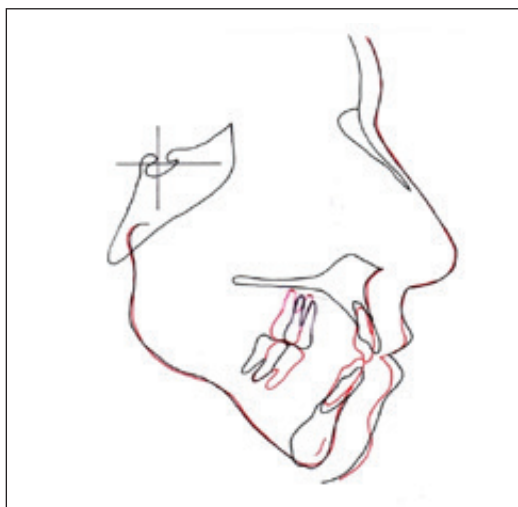


Figure 10. Total superimpositions done according to Bjork's structural superimposition technique.

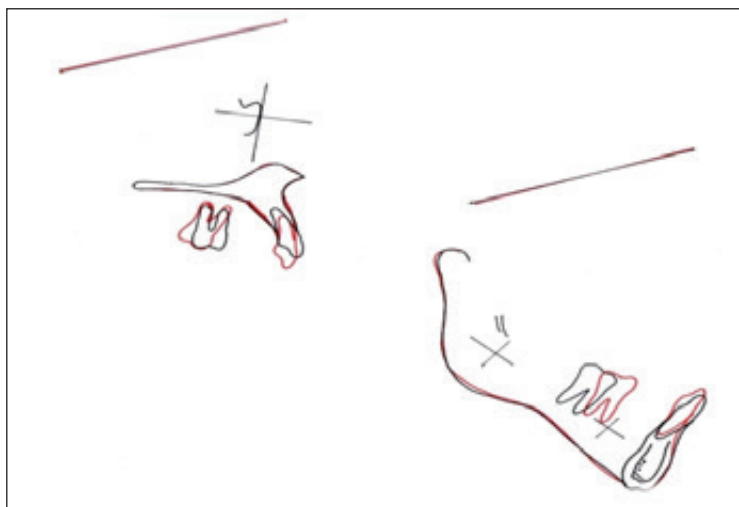


Figure 11. Local superimpositions done according to Bjork's structural superimposition technique.



Figure 12. Extra- and intra-oral photographs of the patient after 10 years follow-up.

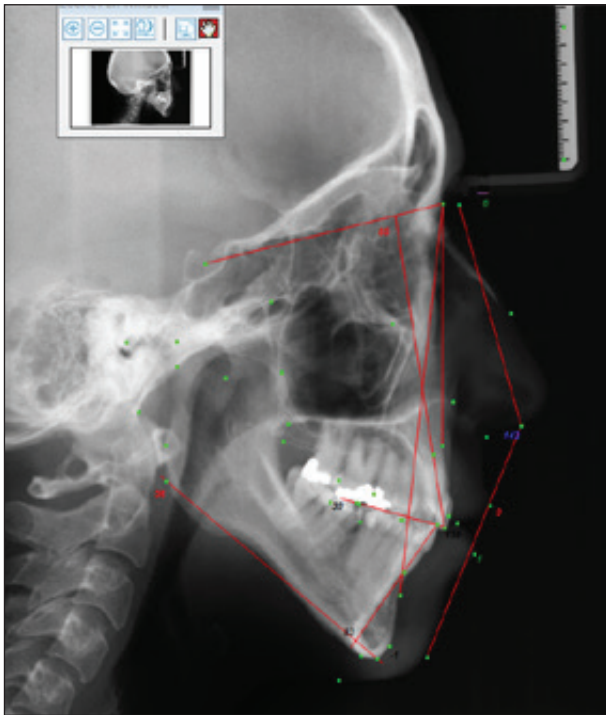


Figure 13. Lateral cephalometric radiograph of the patient after 10 years follow-up.

Discussion

An anterior open-bite is characterised by the over-eruption of maxillary posterior teeth.^{3,4} Adult cases tend to relapse following non-surgical correction, making treatment a challenge. Of the many treatment options for open-bite described in the literature, the use of skeletal miniplate anchorage for molar intrusion has been recommended.²⁵⁻²⁹ However, the procedure may also result in a counter-clockwise mandibular rotation as a result of the molar intrusion.³⁰ De Clerck et al.²⁰ developed a zygomatic anchorage system that employs mini-screws placed at the inferior border of the zygomaticomaxillary buttress between the first and second molars at a safe distance from the molar roots.

In the presented case, zygomatic miniplate anchorage was used effectively to correct a skeletal open-bite. Treatment produced an Angle Class I molar and canine relationship and a normal overjet and overbite as well as the correction of dental midline deviations. The treatment results were maintained over a follow-up period of 10 years, with the amount of observed relapse within acceptable limits.

Previous studies have reported differing levels of force used for molar intrusion. Park et al.²⁴ and Yao et al.³³ applied forces of 200–300 g and 150–200 g per tooth, respectively, whereas Erverdi et al.,¹¹ Akan et al.²² and

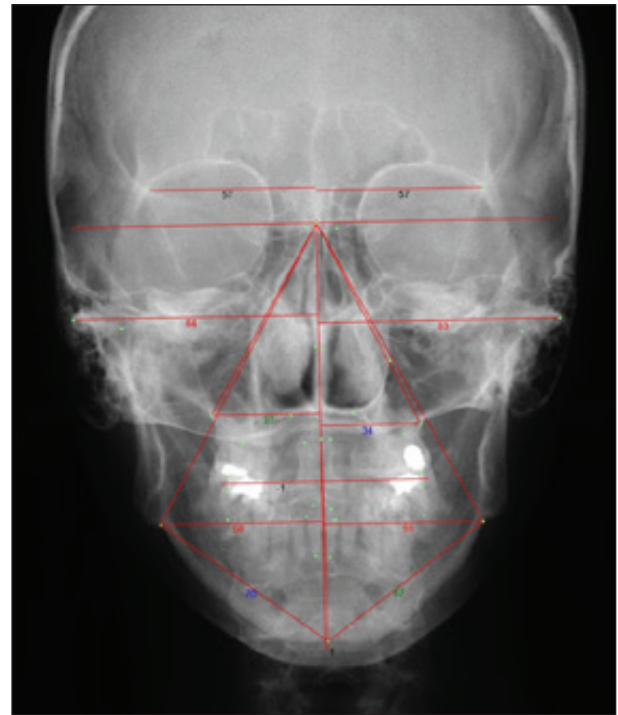


Figure 14. Posteroanterior radiograph of the patient after 10 years follow-up.



Figure 15. Panoramic radiograph of the patient after 10 years follow-up.

Sugawara and Nishimura²³ applied 400 g of intrusive force on each maxillary posterior segment blocked by acrylic. For the present patient, 400 g of intrusive force was applied to the posterior segment on each side.

The current case showed intrusion of the maxillary posterior teeth, while Seres and Kocsis reported mandibular autorotation of around 3.1 degrees to close an open-bite using zygomatic anchorage.³¹ The different results could be due to differences in mechanics and/or superimposition techniques.

Maintaining post-treatment stability is known to be an important challenge in orthodontics, particularly for open-bite cases. Deguchi et al.³⁴ found the

correction of an anterior open-bite achieved using a temporary anchorage device (TAD) to be slightly more stable than conventional methods after two years of retention. As a precaution, maintenance of the TAD was recommended during the retention period in company with supplemental retention methods, such as occlusal stops in the mandibular molars and myofunctional therapy, in order to maximise stability. In contrast to both Baek et al.³⁶ and Deguchi et al.,³⁴ who reported high relapse rates, Marzouk and Kassem³⁵ showed smaller amounts of relapse following intrusion of the posterior teeth (mean: 0.41) and overbite correction (mean: 0.77 mm) four years after debonding. Proffit et al. reported an approximately 10% likelihood of a 2 to 4 mm long-term relapse toward an anterior open-bite after superior repositioning of the maxilla.³⁷ This is an important finding to allow comparison of skeletal miniplate anchorage versus orthognathic surgery alternatives.

The literature mentions several complications and side effects of zygomatic anchorage use, identified as irritation of the buccal soft tissue and mucosa, tissue inflammation, plaque accumulation, irritation of the cheeks, mild postsurgical pain and facial oedema, and possibly apical root resorption.^{10,31,38} Ari-Demirkaya et al. reported minimal apical root resorption of no clinical significance following the intrusion of maxillary first molars using zygomatic anchorage.³⁹ In the present case, despite some minor inflammatory changes observed around the miniplates, for which the patient was instructed to use a chlorhexidine rinse and maintain rigorous oral hygiene during the treatment period, there were no major complications. A temporomandibular joint evaluation revealed no signs nor symptoms of dysfunction, there was no movement of the miniplate during the treatment period, and no significant root resorption observed during the 10 years of follow-up.

Conclusion

The use of zygomatic miniplates to provide skeletal anchorage represents a viable option for the treatment of an anterior open-bite in adult cases to eliminate the need for intermaxillary elastics and associated patient co-operation, as well as avoid orthognathic surgery. In the presented case, zygomatic anchorage, used to correct an anterior open-bite, resulted in an Angle Class I occlusion, ideal overbite, an improved facial

profile, and corrected dental midlines. These results were maintained at acceptable levels after 10 years of follow-up.

Conflict of interest

The authors report no professional or financial conflict of interest in relation to this case report. The patient provided permission for the publication of her clinical data and photographs.

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